Reading Construction Documents & Plans

An Illustrated Instruction Book

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Reading Construction Documents & Plans
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Preface – What Good Is *Another* Construction Document Reading Book!?

This Construction Document Reading textbook is for Construction Technology instructors and their advanced secondary/college-level students. The course suggested in this book aims to present within a concise, scaffolded and student-centric format some fundamentals of construction document reading, towards a general foundation course and CDR certificate, within a 2-year Construction Technology program.

The Author's premise is that the field of construction is a world in and of itself, with a unique language that is 5,000 years old. Construction drawings represent a graphical vocabulary in that ancient tongue. It follows then that Construction Plan Reading should be taught as a 'foreign language', with all the tools & tips used for successfully teaching any visual language skills. This helps students learn construction lingo, and feel more comfortable within the overall structure of design development and construction phasing, which you will soon come to understand.

The Author's belief is also that digital 3-dimensional (3D) perspective drawings, which have widely permeated the construction planning stage as Revit® and BIM, have made largely obsolete previous construction document reading textbooks that are based on 20thC 2D orthographic presentations. *The relevant fact is, most people cannot read 2D drawings, even with foundation-training!* Then a 2D format is a weak learning format for a CDR textbook, when the natural-acquisition of a 3D perspective (and 4D animations) more easily translates into 2D reading later.

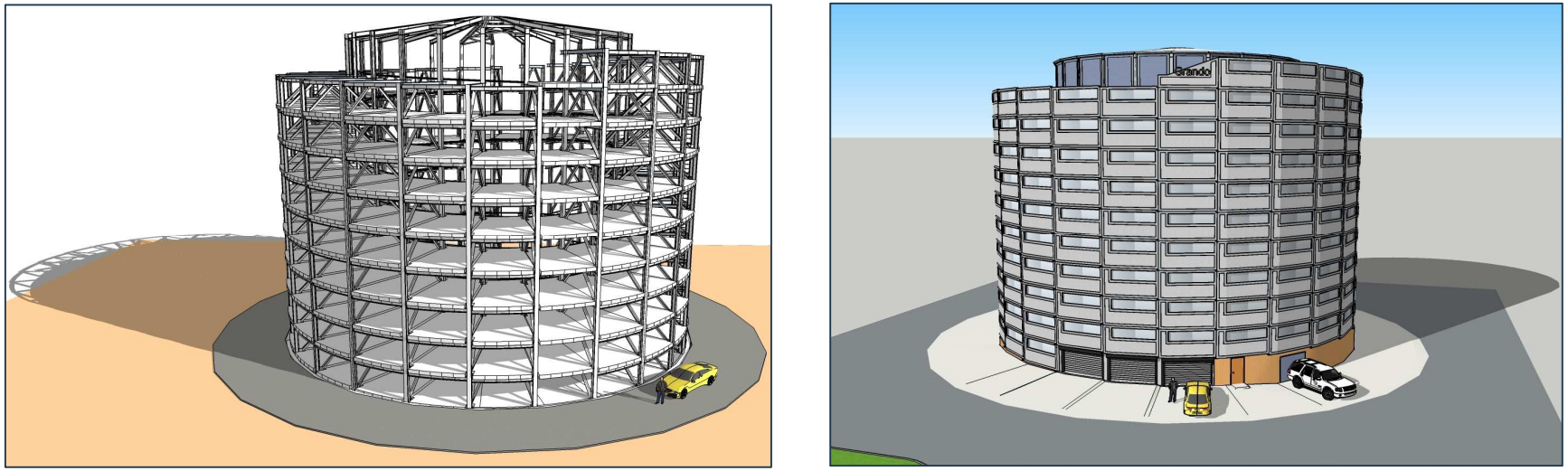

Figure 1- Structural Frame and Exterior Shell Renderings

We can demonstrate (see above) how easily 3D construction documents are to interpret. Study the structural frame illustration, and then the conceptual rendering. With just these two rendered 3D sketches, *and even with no prior training in plan reading*, you could easily explain this project to a classmate: it's a helical cylindrical (automated) parking garage, topped with a mechanical equipment penthouse. It has three vehicle loading-and-unloading bays at the ground level, as well as an operations man-door and a maintenance roll-up door. That was easy, right?

Construction document reading also requires that students move away from their social language, its pop grammar and slang, to using the sophisticated terminology for both the design disciplines and the trades. So what are we talking, 'terminology'? See if you can read this text:

> *"I cdnuolt blveiee taht I cluod aulaclty uesdnatnrd waht I was rdanieg! The phaonmneal pweor of the hmuan mnid is, aoccdrnig to rscheearch at Cmabrigde Uinervtsiy, taht fnoud, it dseno't mtaetr in waht oerdr the ltteres in a wrod are, olny taht the frsit and lsat ltteer be in the rghit pclaes!"*

The reason you can read this text actually has less to do with the 'phenomenal power of the mind' to unscramble letters in real time, than with our mind's ability to goal-seek for quick understanding. If this were written in Latin or in Greek, you would be lost, right? The same goes for Construction Lingo, an old language going back *at least 5,000 years*. Nobody is going to let you work in their design office or a construction site if you're saying, 'This one' or 'that one' or 'those things'. What things? Those! You *have to learn the lingo,* not just of construction work, but the shorthand of construction design plans. Otherwise, you're *jsut sekapnig gbboldeogok!* Use all the 'learning a second language' tricks:

Make your own set of design lingo flash cards;
Connect with local construction tool rentals;
Study up construction language *every day*;
Construction dictionary app on your phone;
Lowe's & Home Depot as your study resource;

Here's a quick example of learning the correct lingo: A 'light', like you think of as 'turning on the light' is called a 'luminaire' by the architects. But a 'light' in architecture is a window pane in a door or window. Dictionaryofconstruction.com

Students should also sketch-copy material in this book in their own hand, in order to learn stylistically and give tactile meaning to the words, lines and symbols they are seeing written up on the whiteboard. Could you imagine, say, learning guitar by reading sheet music, *...but without ever playing one in your hands!?* What if you took a welding course, with trade manuals, codes memorization and 'how to' YouTube, *...but never got to hold a welding 'gun'!* You can't expect to learn construction document reading without first being an 'apprentice' in the art of sketching, drafting and modeling. That means *practicing your sketches*. We have included *excellent* sketching and design references in the Bibliography, for your use in learning to hand sketch. Sketching *profoundly* 'lights up' the neuroimaging observation portion of your mind! [1]

SketchUp (or OnShape) are *free download* design-drafting tools that you can use to gain in 3D CAD proficiency, by watching on YouTube. Some few SketchUp tips: keep the blue axis up; draw on the red-green plane, then extrude up on blue; SketchUp is 'sticky', so to prevent objects sticking, as soon as you draw one, Edit-Make Component; as soon as you have components built, then Edit-Make Object the group.

Here's an example of the powerful difference between a 2D CAD fabrication drawing, and 3D rendering for understanding the concept:

[1] - http://www.wsj.com/articles/the-power-of-the-doodle-improve-your-focus-and-memory-1406675744

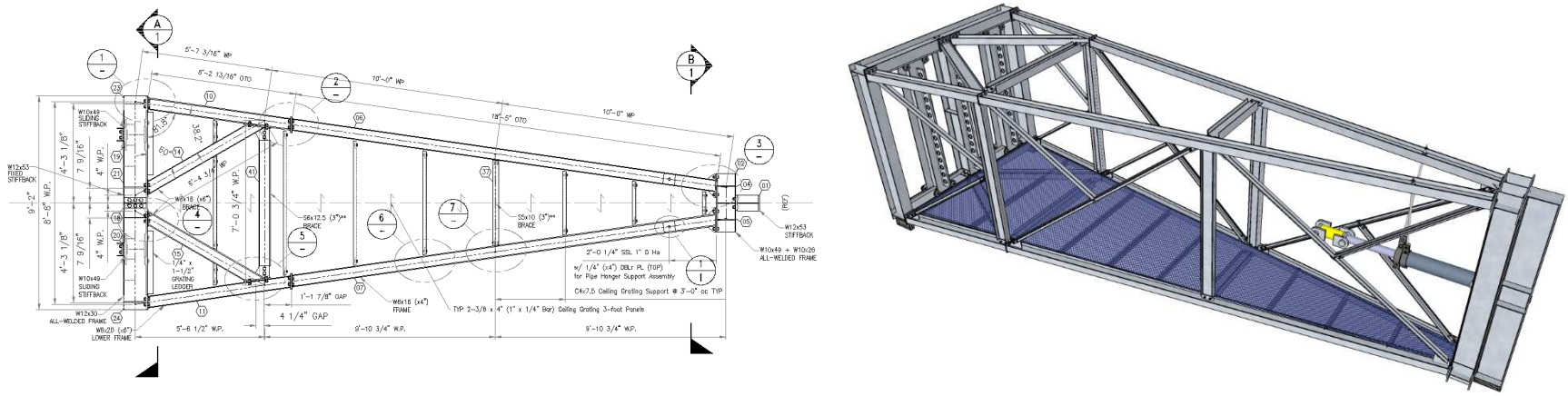

Figure 2- 2D AutoCAD Plan View and 3D SketchUp Isometric View

The powerful ability of 3D imagery to change the way the construction business looks at drawings is available in an app. Each sheet of a 2D construction document has a unique QR code scanning barcode. Holding your cell over the 2D sheet shows you a 3D illustrated version of it!

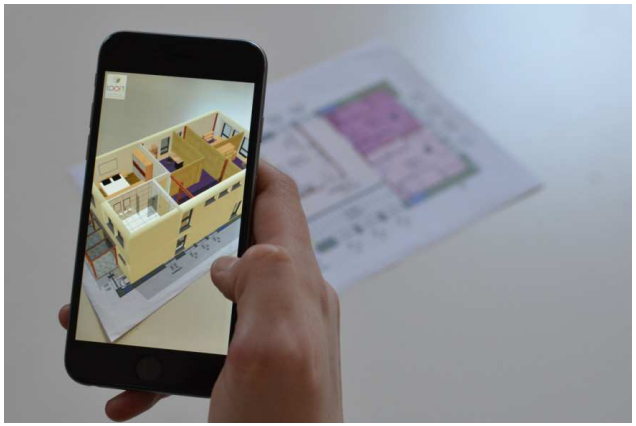

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Figure 3 - AutoDesk Augment ™ 3D Android App

Again, this is a *foundation* course, accessible to anyone who takes the time to work through it, *with no special pre-knowledge or experience*. Throughout the book, students will learn *what* each discipline does, and *where* it's represented on construction documents, but will not have to learn *how* they do it. For example, you will learn what a foundation engineer does, with an explanation why, and where to find and how to read foundation drawings, but you won't have to learn how to do foundation engineering. You'll need to focus on the math and geometry presented, but again will not have to learn *how* to do the math. (You should already know how!) You are also expected to use YouTube and Google Search skills to deeply investigate any topics or discussions that you're not fully understanding with this course book, or your in-class work.

How about we do another 2D versus 3D comparison, to make sure you understand the approach to learning we propose in this textbook:

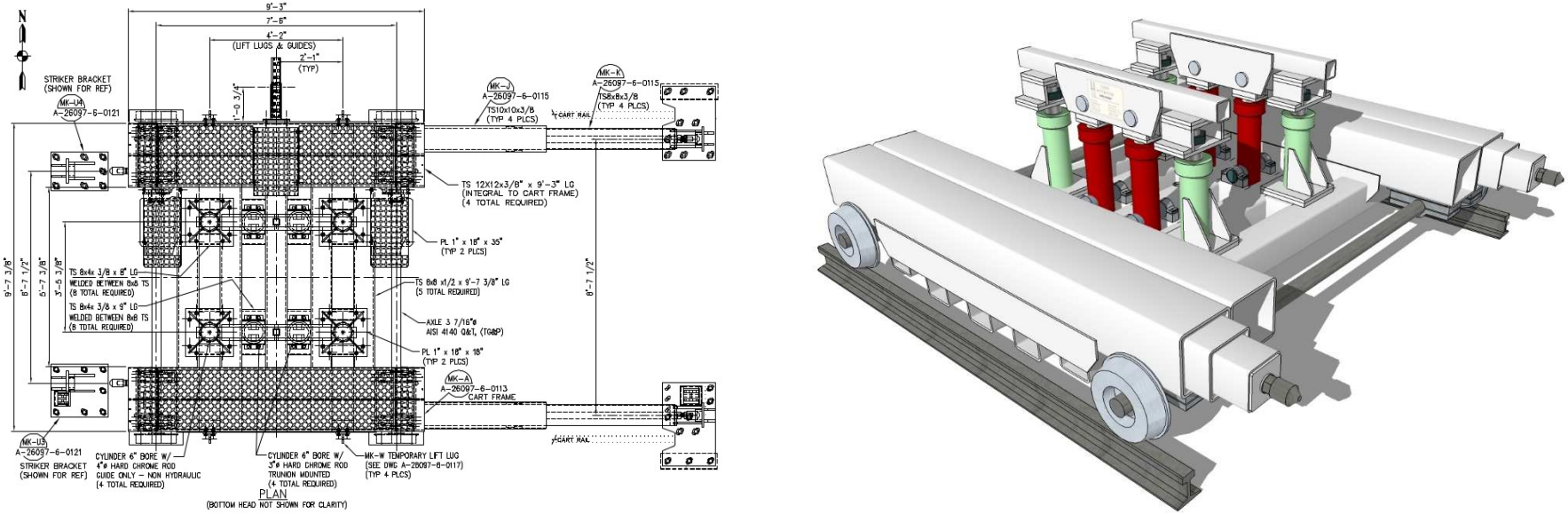


Figure 4- 2D AutoCAD Plan View and 3D SketchUp Isometric View

You and I would probably both agree we can't tell what we're looking at in that 2D plan, even if we could interprete the lines and symbols. It would take a careful examination of the orthoganol viewports to get a basis understanding. How is this the best way to teach plan reading? More to the point, the time constraint to teach how to visualize, maybe not correctly, 2D plans means there is little time available to teach the construction process, or the vast volume of other construction documents which are more critically important to understand than plan reading.

We will be using 3D illustration at every opportunity to scaffold students and correctly visualize what they are reading, so that more time is available for construction specifications, bid documents, project management and quality-assurance forms: critical construction documents! This allows CDR students working with this textbook the opportunity to learn not just the lines and symbols, but the complete construction process from the initial Basis of Design development master planning, to the final Punchlist Inspection, As-Builting and Operations Manuals

Actual Plan Sets: This is only an instruction book, and not an actual set of construction drawings. *You'll have to find plansets to practice with!* Best bet is find a municipal utilities project bid listserve, put your name on the respondents list, then pay for a set of those bid documents. It's worth every penny to have a printed plan set you can lay out on the floor then really study and mark up. Now it's yours to redline and yellow highlight, to tear apart late at night, searching for the unified basis of design stated in its project intent. You can also find municipal utilities project bid registration sites with free PDF planset downloads (then have to pay to get them printed out, at least 11x17, at the school library). Google 'municipal construction bid registration site', 'http://www4.bxwa.com/fb/private', or: https://www.periscopeholdings.com/bidsync/

● TASK: *Throughout the unit chapters, classwork tasks will be bullet-highlighted, and described in italics. Take a moment to read this plan:*

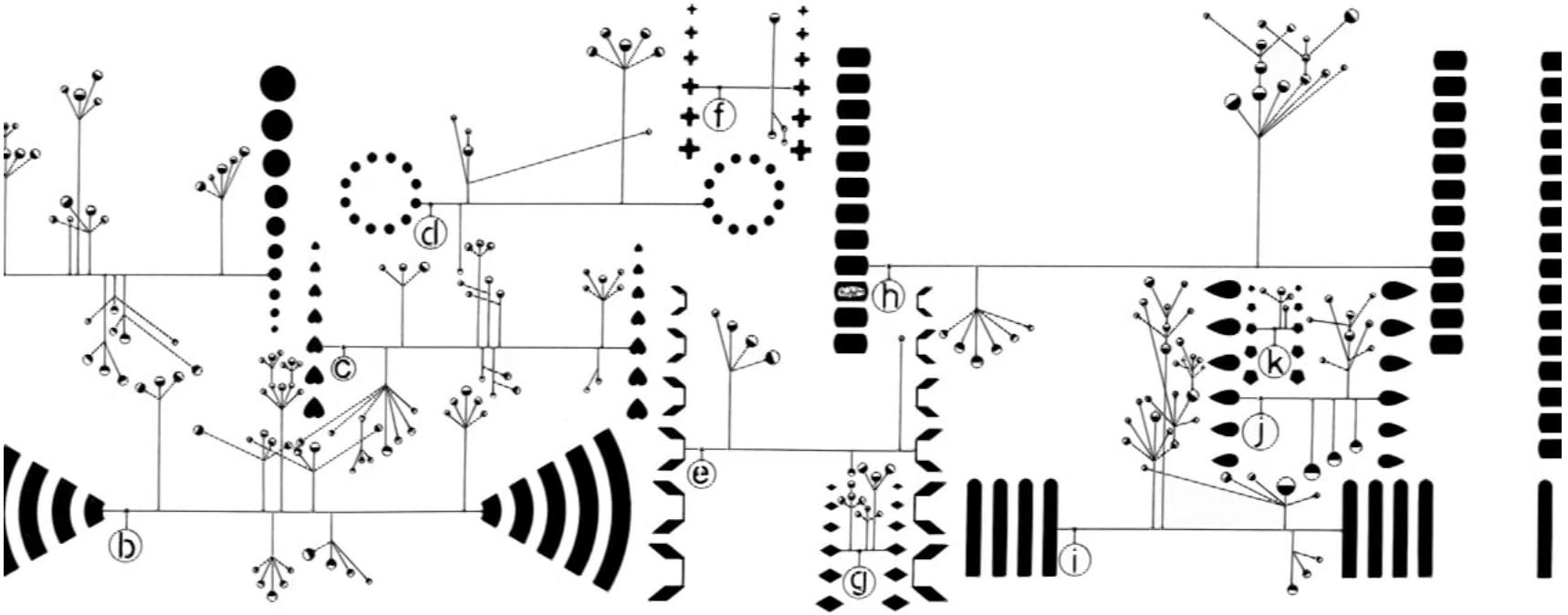


Figure 5- Metaphysics of Notation (Mark Applebaum)

In teams you choose, and using your cell phones, translate these graphic images, then discuss what 'semiotics' means for construction plan reading. How will you make use of search engines to interpret the construction language words and symbols you will have to master, not just what they mean, but also be able to visualize the construction processes that they refer to, in order to find errors and omissions in the work? What good is learning what a sign or symbol means, if you don't also understand construction design and trades standards? When you make strong efforts to learn systems, not just symbols, your perception unleashes tremendous creative energy, with the power that will give to you.

Learning Engagement: Deployment of this coursework material works best by keeping lectures short, with a 'learning resource' model featuring interactive exercises and 'flipped-classroom' student assistance. The instructor can rely on their own enhanced lesson plans, by pointing to the textbook, with solutions to frequently asked questions, exit slip challenges and some online quizzes and tests archives. Unlike the differentiated subjects, CDR cohorts must 'march' together, using frequent A/B and A/B/C/D teamwork, then all-group discussion over that day's set of plans.

This course relies on presentation of materials in a way that embodies substantive intellectual engagement (reading, thinking, writing, sketching and problem-solving), so that students 'take ownership' of their CDR studies, in class and in homework, to develop, test and remediate their learning acquisition, until they have acquired all the materials presented in this course. More than that, because design and trades construction relies on the 'buddy system', it's desirable that the students work efficiently in groups, and it's paramount they learn to quickly form into A/B

pairs and A/B/C/D work groups, expressing to each other and also their instructor the challenges and proficiencies they face in every unit. When CDR graduates get out into the office or the field, every day may be a new work team, under a new trade foreman, or a different design captain.

Learning Assessment: There is little homework in this course book. Why? We recognize that students rarely read ahead, and are unlikely to do any homework, ironically, even though both of those activities are *absolutely essential to success* in the field of construction! Instead, before the completion of each weekly unit and its quiz, you will be asked to develop an assessment rubric with your A/B/C/D work group, then go over in large group discussion what things you feel are necessary to retain, regardless of how you do on the quiz, as part of your instructor's grading. At the end of the course, you will be asked to assess this course book and your instructor, so write down these group discussions from every unit.

● HINT: *Nobody knows what Mark Applebaum's inscriptions mean! They are meant to disassociate you from attempting to find any meaning.*

Learning Outcomes: At the completion of this CDR course of study (two 90-minute classes per week, 16 Units over 16 weeks), students have:

- Explored both design-drafting in 2D and design-modeling in 3D, using hand-sketching;
- Developed in-depth understanding of all the design disciplines and construction trades;
- Gained a *general* capability to read construction documents for the crafts and disciplines;
- Prepared themselves to enter a design-study apprenticeship program in the A-E disciplines; -or-
- Prepared themselves to enter a crafts-study apprenticeship program in the construction trades.

Your mantra for joining the 21st Century construction industry must be, *"Faster ... better ... cheaper ...* ***and a lot smarter****!"* Good luck!

Introduction – Daily Log of Instruction and Homework Record

Learning Objective: Students develop a daily study-record log and homework record as a portfolio for their future apprentice work-study.

All construction projects, whether the design process or the field construction, employ a Daily Diary. A Daily Diary is just what it says it is: A Daily Log of Construction Activities and Agreements. For example, what were you doing and who were you with, what did you decide and what was directed to achieve, say, on November 17th, 2015? And you'd better know the answer on that hundred-million dollar project!

> *"Steve, you were the MEP Superintendent on the 44 Union job in 2015; the attorneys want you at their office tomorrow for your Affidavit. Please make sure to bring your Daily Diary, so they can scan the pages."*
>
> *"Bring m-m-m-y what?!"* (ROFLMAO, …but 'Steve' was me, and we all had to learn this the hard way)

We can laugh at others' misfortune, but Steve isn't the only one about to suffer. In the legal game of 'he said – she said', if you don't have your Daily Diary, or a good corroborating witness, the firm that you work for can be deeply on the hook financially. One identifying mark of a true construction professional is how well they keep their Daily Diary, because they all know from experience what can likely happen if you don't.

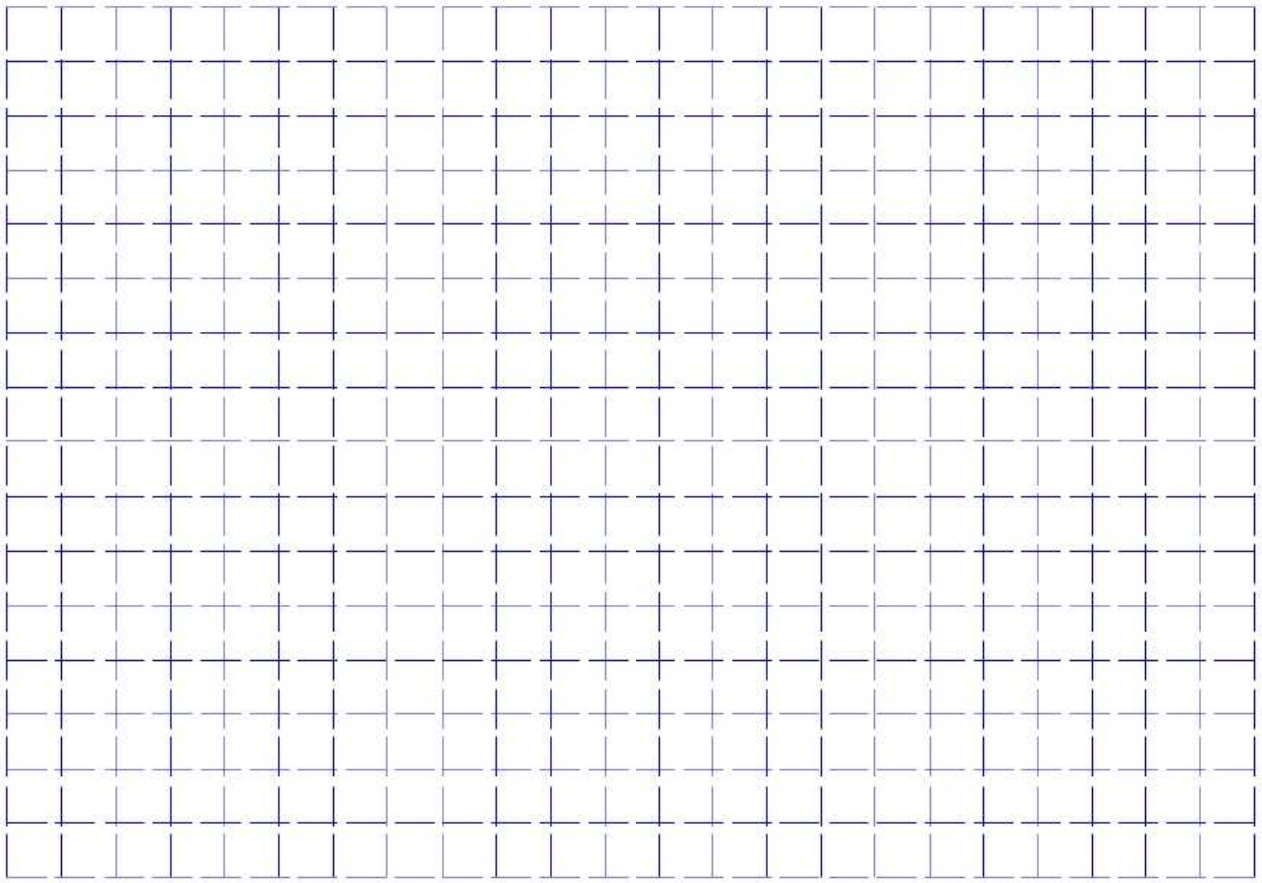
Students will keep their Daily Log of Instruction, in preparing for that day when they are 'put in charge'. For a Daily Diary, we like soft-bound *graph-lined* notebooks, e.g. Blueline NotePro Quad & Ruled Notebook, Black, 9.25 x 7.25 inches, 192 Pages (A44C.81), or Office Depot Dual Ruled Marble Composition Book, 7 1/2in x 9 3/4in, College/Quadrille Ruled, 100 Sheets, Black/White, 400-003-275, where pages can be used for daily note taking and for sketching. You can also xerox loose-leaf copies of the following form sheets (see next pages). Your instructor will have you hand in your Daily Diary and Homework after every week of instruction for your 'exit slip', then return them before the next week of instruction. Please keep scratch notes in a binder or A-size design portfolio. Your teacher will grade your work, and you will also grade your Teacher's presentation in the last unit! You are the 'Owner' of this instruction course, and the textbook and your instructor are your 'Contractor'.

That co-grading exercise will build an internal 'give and take' that's essential when dealing in a *high-energy* construction environment and is the *very essence of learning effective decision making and resource management.* You are expected to show up for every class, on time, and make every effort to study and acquire the materials being taught, as well as doing all the classwork and homework. In return, your teacher, as your 'Contractor' has the additional obligation to make sure you are successfully understanding their instruction, throughout their lesson planning.

Then, in the graph-lined drawing area, you are expected to keep sketching what you are seeing, in a way, 'doodling' like students will do, but in this case, your 'doodles' should reflect the drawings and graphics that you're being instructed on, in every class. Whether you are a good sketch artist or can't draw a straight line is immaterial. *This eye-hand coordination effort to draw is what trains your mind to <u>read</u> drawings*, and the discipline of coursework, homework and grading is building that mental fortitude to succeed within the tough construction profession. Make the effort to handwrite legibly and sketch carefully. Avoid scribbles or doodles. **Your Daily Diary is a work portfolio for that first job interview!**

DAILY LOG OF INSTRUCTION

SKETCHES OF CLASS NOTES HERE:



INSTRUCTOR & THEIR TITLE:	M T W Th F	DATE:	
	COURSE NUMBER & TITLE:		
SUBJECTS DISCUSSED:	HOMEWORK GIVEN:		
		GRADE	
		Good	Weak

TEACHING METHOD: (Talks, Teams, Games, Videos)	GRADE		SUGGESTIONS FOR IMPROVEMENT:
	Good	Weak	TEACHER:
			STUDENT:

LIST OF NEW TRADES TERMS & LINGO I MUST LEARN TODAY:	LIST OF NEW DESIGN TERMS & SYMBOLS I MUST LEARN TODAY:

So what are the impediments facing students of Construction Technology, other than they have little or no field hands-on experience with it?

Abstract Terminology – CT is the largest industry in the United States (world), with the longest history, over centuries. There is, and will continue to be, abstract terminology. What's a 'darby'? A 'jitterbug'? What's a 'torch'? A 'spud wrench'? Those are just the easy ones. How about '8B J-box', 'kleins', 'fish tape', 'hog head' and 'homerun'? *There's just no getting around the lingo* Students in CT should expect to spend one day a week at Home Depot or Lowes, in construction sales and equipment rentals, after school, asking the store representatives what all 'this stuff' and 'these things' are, and taking notes so they don't forget. Practice, practice, practice. *Now let's get that RJ21 Cat5e 25 into the RMC on the CTS, then it's Beer:30!*

Overwhelming Content – Every technology today is *drowning* in overwhelming content, whether you pull comm cable for a living or fly an AirBus or write Java Script code. Apprentice programs are deliberately designed as tiered-instruction, each step is incremental, presented in contextual format, then formatively-assessed with a quiz and maybe an exit-slip exercise. *Not all students learn this way.* An argument can be made using a workbook guide like this one, to alternate days of tiered-instruction with days around a homework-assignment lecture for Q&A. Then apply immersive training, breaking students into 4-person teams around resource-student 'foremen', those who are the fast-acquirers (teachers immediately recognize who those are), before handing out actual full construction document sets. Let students engage in a period of sheet-flipping observation and study, followed by a relay-race search and identification game.

Lack of Hands-on Learning – The summative assessment of any teacher's success is in *kinesthetics*. Since 'peanut gallery' jobsite visits are no longer feasible due to liability, and many CC-level colleges rely on adjunct instructors to provide their own *manipulables*, getting hands-on learning is a real challenge. You can bet a heavy-equipment simulator would 'seal the deal' on the Civil Unit lessons.[2] The same goes for a welding simulator on the Structural Unit.[3] 3D VR will soon open up many other avenues for electronic-learning, leaving the instructor free to 'flip the classroom', in order to walk around and closely observe the students' enthusiasm and acquisition. There are videos with master tradesmen explaining work step-by-step.[4] Still, it's not *kinesthetic neuroimaging*. What I found useful as an alternate was role-playing. Students who require *realia* to engage with, will often enjoy role-playing in the trades and disciplines. I also urge serious students to take *sports visualization training*. Learn how to shut out all distractions, and intensely focus on your work.

● TASK: *Again, suggest tasks and group exercises throughout the workbook, to make sure students are fully scaffolded for what to expect before doing those lessons, and are ready to acquire the instruction set for the class period after the exercise, as well as carefully logging and sketching what they have learned in each class period in their Daily Log of Instruction, and what they will need to take home to study further.*

Homework Assignment – Go to: http://www.wittycomics.com/make-comic.php and prepare your brief project development cartoon that you believe are the basic steps necessary to purchase a piece of land, get bank financing and build a house. Read the first unit. Research a little if you want to. Be creative, be funny, spill some ink, but be accurate. See, graphically, how quickly you can illustrate this development process. Then have your instructor sign off for the extra credit on Unit One, on your Student Unit Classwork Report. *Keep working for those credits!*

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[2] - http://www.thoroughtec.com/cyberquip-construction-excavator-simulators/
[3] - http://www.123arc.com/
[4] - https://www.youtube.com/watch?v=b2KfsJoZCnM

STUDENT UNIT CLASSWORK REPORT

NAME:	COURSE NO & TITLE:
INSTRUCTOR:	YEAR/SEMESTER/QUARTER:

CLASS	UNIT	CREDIT	CLASS	UNIT	CREDIT	CLASS	UNIT	CREDIT	CLASS	UNIT	CREDIT
1			9			17			25		
2			10			18			26		
3			11			19			27		
4			12			20			28		
5			13			21			29		
6			14			22			30		
7			14			23			31		
8			16			24			32		

LOG BOOK CREDIT HOURS	

Introduction Questions for Review:

1. Daily Instruction Logs are necessary because it's: A. fun task; B. smart tool; C. legal requirement

2. A Report of Student Classwork is necessary for: A. attendance; B. test scores; C. work portfolio

3. By completing this course, students can: A. operate equipment; B. graduate; C. be an apprentice

4. Sketching to learn CDR reading is like: A. tasting food as a chef; B. playing soccer; C. watching TV

5. Grading your teacher is: A. taking charge of your studies; B. punishing them; C. like 'New Math'

6. The term '3D' refers to: A. wearing special glasses; B. plans that are easy to read; C; bad grades

7. 'Rendering' here means: A. boiling lard out of meat; B. paying taxes; C. sketching out your design

8. Daily Log Book record forms are prepared by: A. the teacher; B. the student; C. the school Dean

9. How many hours are required for CDR reading mastery? A.200; B. 10,000; C. your entire career

10. Affidavit is where you: A. swear to your memory; B. pay student fees; C. hand over your Diary

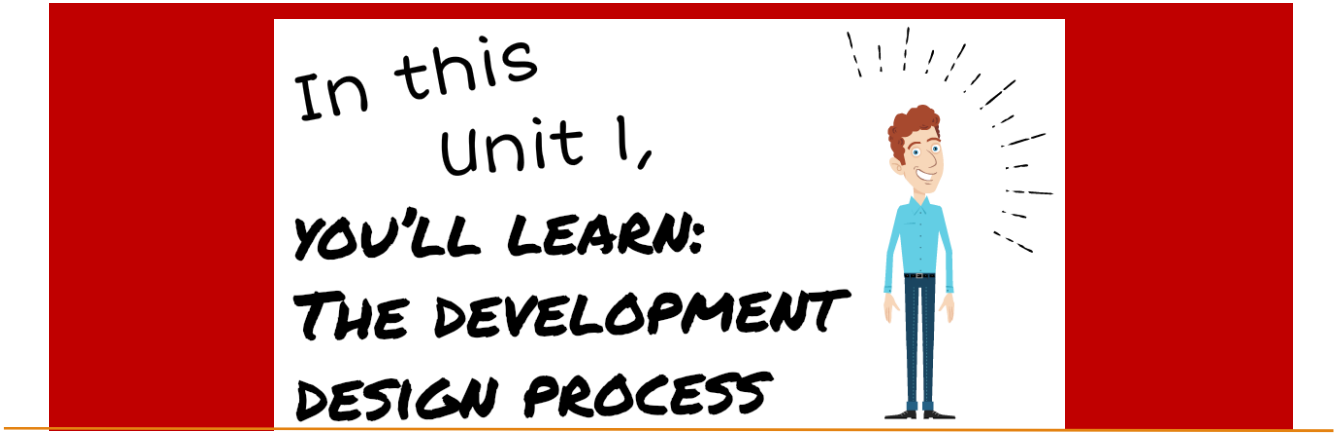
Throughout this workbook, teachers and instructors should focus on providing guiding questions (i.e. What is the task? What does this word mean? Where are we in the process?) Be informational, argumentative and narrative. Direct students to identify the construction document vocabulary and in pairs determine their meanings, use flashcards to perfect their understanding, then add to the vocabulary in their notebooks. For differentiated learners, make sure that every day students get their hands on *full-immersion document review sets*. [5]

Word for the Day: "**Time is of the Essence**" – A 'Time is of the Essence' clause means that one party to the contract must perform its individual contractual obligations within a specific date and time as required in order to compel performance by the other party to the contract. A failure to perform by the time specified will be a material breach of the contract. Your instructor's lesson plans and your classwork completion fall under the rubric 'time is of the essence'. If you don't complete the coursework, then it's all just wasted time and money, lost in the rear-view mirror.

[5] - http://www.ascd.org/publications/books/107040/chapters/Success-for-all-Students-in-Inclusion-Classes.aspx

1 – Where to Begin?

Learning Objective: Students develop an initial understanding of the development design process and the documentation that is required.



A year or sometimes years before you see any heavy construction equipment show up on a job site, there is a long development design process. Let's do a thought-experiment: You're on Google Maps, and you see a nice stand of trees with a year-round creek, it's up against State forest on three sides, and served by a paved road with a powerline out front. You call up the County Title, and find out that the parcel may be for sale!

Well, you could hire a Builder, a Well Driller and a Septic Installer, and take their sketches to the County for permits, then you'd be finished with the construction document paperwork. There are still jurisdictions that let you build that easily! While it may not be that hard to build far upland, out in the County, most development occurs within a very competitive and chaotic urban environment. So we'll present for you the whole process, from Initial Conceptual Design on through Issued For Construction (IFC) documents delivery, and then to a Final Punchlist.

Remember to wear your Personal Protective Equipment (PPE)!

● PROPERTY DEVELOPMENT PROJECTS START HERE ►

Property Scouting (Title Search) searches for available and buildable parcels that can be developed *as they are zoned*;

Pre-Development Assessment (Design 'Pre-Dev') screens for any buildable parcels that can be developed *at a profit;*

Pre-Development Approval (Pre-Permitting) with jurisdiction over pre-dev to see if it *has any 'show stoppers';*

Here are the title search results on the properties
We'll get our pre-dev assessors started on it
These pre-devs look good, call the County
Right, boss, I'll get an appointment today
So what do you think, are these permitable?
Looks like you may have some buildable projects

● OK WITH TITLE AND PRE-ASSESSMENT? (continue) ►

Property Survey (Land Survey) measures and defines property and land slopes and contours, *identifies buildable/unbuildable areas;*

Geotechnical Survey (Soils Survey) measures and defines property soils and rock strata, *identifies buildable/unbuildable areas;*

Hydrologic Survey (Storm Detention) with jurisdiction re *post-development site runoff*, to see if it *might be a flood zone*;

Ownership said to go ahead, hire surveyors
I'll get their contracts signed and POs issued
I think we can say you have a buildable site!
Surveyors said their reports show we're on
Wanted to check County is OK with our surveys?
We think you have a permitable site here

● OK WITH JURISDICTION INTERIM APPROVAL? (continue) ►

Conceptual Plan (Basis of Design) Architect and Civil Engineer define the scope of project, *identifies roads, utilities, building footprint, etc;*

Civil Plan (Site Engineering) Civil Engineer lays out *site improvements and u/g utilities* surrounding the building footprint area(s);

Building Plan (Building Architecture) Architect lays out *building plans and elevations, along with landscaping improvements;*

Basis of Design should be as a shopping mall
Better idea, let's design a Super Mall concept!
Start Civil design for a shopping mall concept
I'll get a draft site layout to the Architect Friday
Start sketching out a Super Mall for the site
I'll work with Civil to find the BOMA and parking

● OK WITH CONCEPTUAL PLANNING AND BUDGET APPROVAL? (continue) ►

Framing Plan (Foundation and Framing) Architect/Engineer lays out the *building framing and site structures designs* across the site;

Utilities Plan (Building Utilities) Electrical/Plumbing Engineer lays out *utilities for electricity, water, sewer and fire suppression*;

Design Package (PS&E) A/E team addresses *permits, planning & zoning issues, specs and calculates IPMS cost estimate;*[6]

Go ahead and hire our other subconsultants
I'm waiting on the final space planning layouts
We've got the disciplines design work all done
I'll have Ownership review these plans
Here are all the plan documents for review
We'll put your project in for permit reviews today

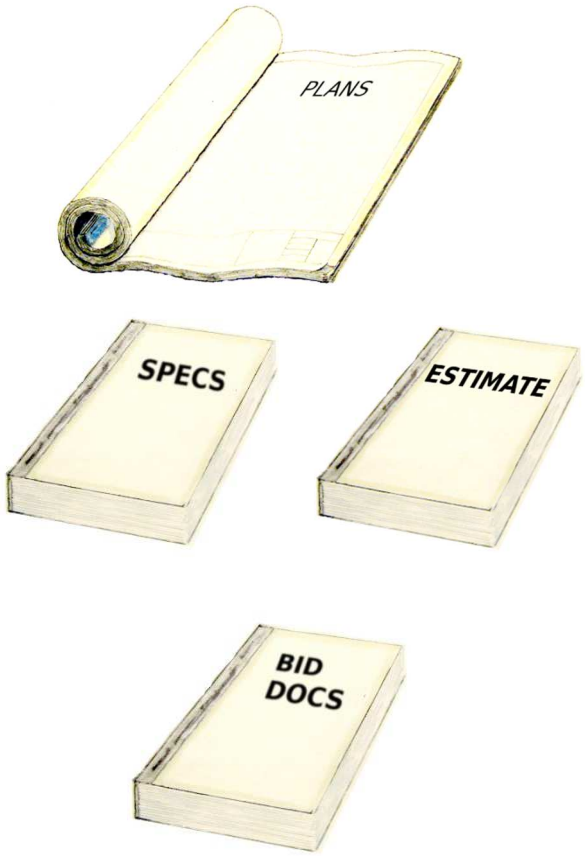
[6] - http://www.boma.org/standards/Pages/INTERNATIONAL-PROPERTY-MEASUREMENT-STANDARDS-(IPMS).aspx

● GO IN FOR PERMITTING REVIEW with PLANS, SPECIFICATIONS and ESTIMATE (PS&E) PACKAGE ►

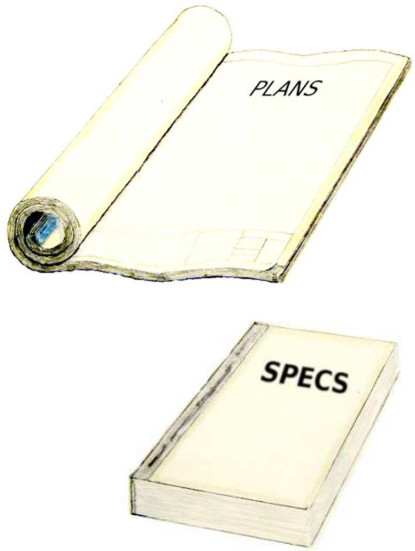
Plans, Specifications and Estimate (**PS&E**), together with the Contract Bid Documents, form the Issued for Bid (**IFB**) bound volumes of legal contract requirements for construction bids and contracting, once Planning & Zoning and Building permits are approved by the jurisdictions. These are collectively referred to as the '*Bid Document Package'*. In this course, you will learn to read and to interpret (just to a certain extent as an apprentice) this IFB package, as well as any Issued for Construction (**IFC**) document packages that may be revised before construction. NOTE: The permitting jurisdiction does not need to see the detailed estimate. Permit fees are based on a Schedule provided in the Code.[7]

The IFB/IFC Document Package from the Architects/Engineers (A/Es) is distributed to the groups as follows (in a DBB, …see next page):

OWNER & CONSULTANTS



PERMITTING JURISDICTION



NOTE: Spec submittals are only required for phases or processes where specific jurisdiction code exists, for example, the storm detention systems or utilities systems may need to meet a Code

GENERAL CONTRACTOR & SUBS

7 - http://web6.seattle.gov/dpd/LUQnA/?Type=2

● TASK: *Break up into teams of A/B/C and discuss why PS&E is distributed as above. Think about what each party needs to see, and what they don't need to see. As a group, with your instructor and any IFB PS&E package you can find online, get a feel for what's in each document set. Map out in a concise outline on the whiteboard what the project Basis of Design is, and what it hopes to achieve. Now role-play. You are going to plan and specify your own* ***sports shoes****! One be Owner, one Consultant and one Contractor, then collaborate on your PS&E bid documents. 'Owner', write your 'needs list' down, pass it to the 'Consultant'. 'Consultant', sketch the pair of shoes. Pass the needs list and sketch to the 'Contractor'. No talking! And no changes, as the 'Contractor' defines the final details, solely according to the needs list and design sketches. Now get together and interview each other. Was the 'Owner' satisfied with the final product? Could the Design-Build team have done better?*

Once the conceptual design documents are approved and the project is deemed finance-able, it will proceed in one of several principal forms:

Design-Build (DB) – In this form, the Owner's own staff prepare *schematic* plans (Basis of Design) and indicate the Owner's intent for the project in General Specifications and Bid Documents. A group of Consultants and Contractors seek each other out and sub-bid to a General Contractor, often through an individual project LLC, to limit liability. The General Contractor provides both Design and the Construction, then may suggest value engineering improvements, or progress the works more swiftly than normal, in return for award incentives. The General Contractor's Consultants prepare the Issue for Construction plan drawings. These are reviewed and approved, with any revisions, by the Owner. The General Contractor then completes the Project.

Design-Bid-Build (DBB) – In this form, the Owner engages outside Design Consultants (and maybe value engineering advisers and independent cost estimators) to prepare the Issued For Bid (IFB) design document plan set. A General Contractor will cost-evaluate the plans, think of their strategy to save costs or suggest alternatives, then solicit for trades subcontractors sub-bid to the General Contractor, who will prepare a bid response. Upon award, the Owner and General Contractor meet to assess the project, then the Owner's Consultants issue a revised Issued For Construction (IFC) plan set. Although this is a firm fixed price bid, because there are three parties engaged, the opportunity for a Changed Condition and Bid Cost change exists.

CM-at Risk (GMP) – A General Contractor provides SubConsultant design services to the Owner, and is Owner's Construction Manager during building construction, with a commitment to deliver the project entirely within a Guaranteed Maximum Price.

Turnkey Project Delivery (Turnkey) – Large industrial projects with tight specifications and industrial standard designs, refineries, for example, often use Turnkey Contractors to Design, Build and Construction Manage a complete facility, ready to operate. Where the Contractor also operates the facility for the Owner, it's referred to as Representative Design-Build-Operate.

The 'advantage' of DB, sometimes referred to as Integrated Project Implementation, is that the Contractor can't easily claim Changed Conditions or get out of Quality Assurance issues by blaming the Consultants, because it's DB. However, unless the Owner maintains their own Consultants to first *carefully* prepare a Basis of Design, detail the Existing Conditions and General Specifications, (as well as protecting the Owner in the Contract Documents), a DB Contractor can easily bid too low to steal the award, then claim 'Changed Condition' or 'Value Engineer' the Owner into either a more expensive project, or if the budget is fixed, the Owners may get a poor-quality project. With design provided by the General Contractor, for a fixed sub-bid from each of their Consultants, the pressure to rush and substitute a poor-quality design or low-quality materials

can often lead to Design Phase delays, if the Owner's Review Consultants rejected the DB GC project drawings package, or the site work.

The 'advantage' of DBB is that the Owner sees and specifies exactly what they should be getting. Their Consultants prepare a complete PS&E packet together with the Bid Documents. If the Consultants are good, and there is a competitive field of General Contractors, then the project will progress smoothly, although not as rapidly, because of the Quality Assurance and Cost Estimating review delays on both sides. Margins are usually very tight, and the General Contractor is left with only their Sub-Contractors and Vendors to 'beat up on' for costs savings. State DOTs, for example, when because work must be done exactly to design and specification, will often go the DBB route, and employ a field QA team. Here though, with three-party DBB, the adversarial process can become blown out of proportion as the Contractor blames the Consultant, the Consultant blames the Contractor, and the Owner is left with cross-conflicting liability issues, that don't occur as easily with a two-party DB.[8]

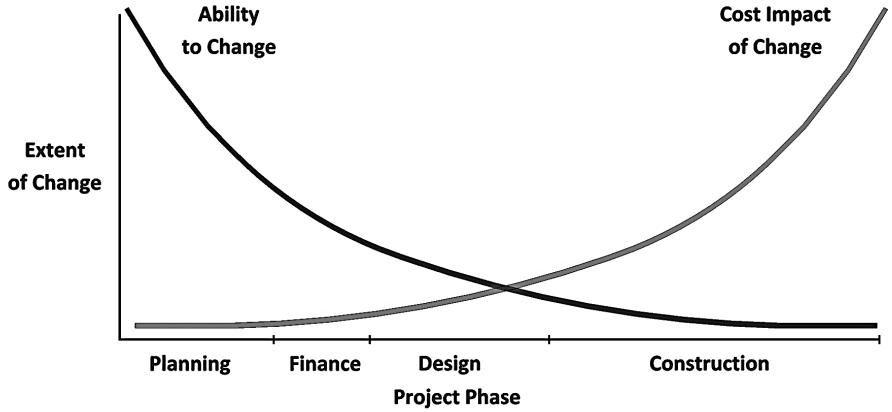


Figure 6 – Change-Cost Project Phase Metric

There are a number of 'Given Wisdom' graphics used in Construction Management, like the one above, suggesting the best time for making change improvements to a project is early on, to avoid large cost impacts. There's also a common chart showing DBs are 'faster' than DBBs, and in commercial or industrial projects where the Owner needs the project online, that is often a consideration. Another chart will convince you that using Building Information Management (BIM) CAD design, with its ability to coordinate all the consultants, (but with a huge cost riser in consultant fees), will help 'minimize' construction changes, and provide a useful 'as-built' for plant operations. *But what it all comes down to is an availability of qualified consultants, skilled contractors, a competent General Contractor, and a competitive bid environment*.

Then what you might take away as a CDR reader is, your own observations, early in the project, may bring significant cost savings, by:[9]

1. Becoming more competent and skilled in reading and understanding IFB/IFC documents.
2. Improving the quality of construction intents: basis of design, guide specs & plan details;
3. Reducing spatial coordination issues using shared 3D modeling design tools (Revit/BIM).

[8] - https://www.dbia.org/about/Documents/db_primer_choosing_delivery_method.pdf
[9] - http://rockymtnashrae.com/downloads/2011_Technical_Conference/tc_fundamentals_2011_construction_documents.pdf

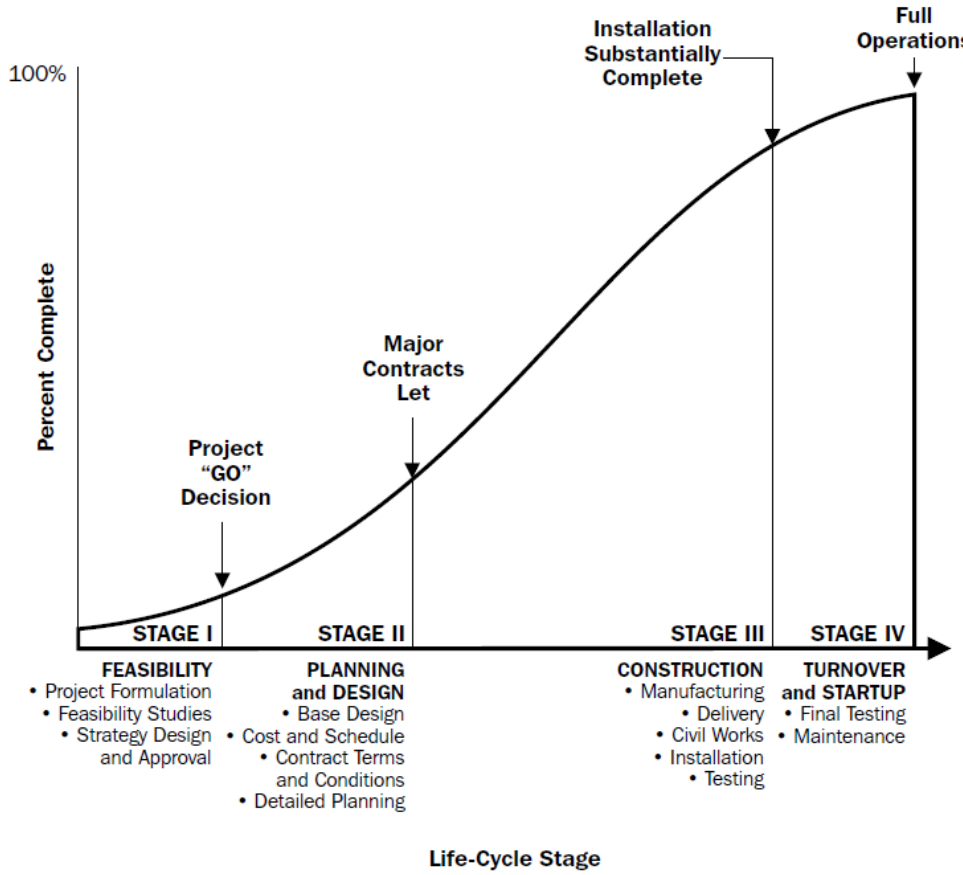


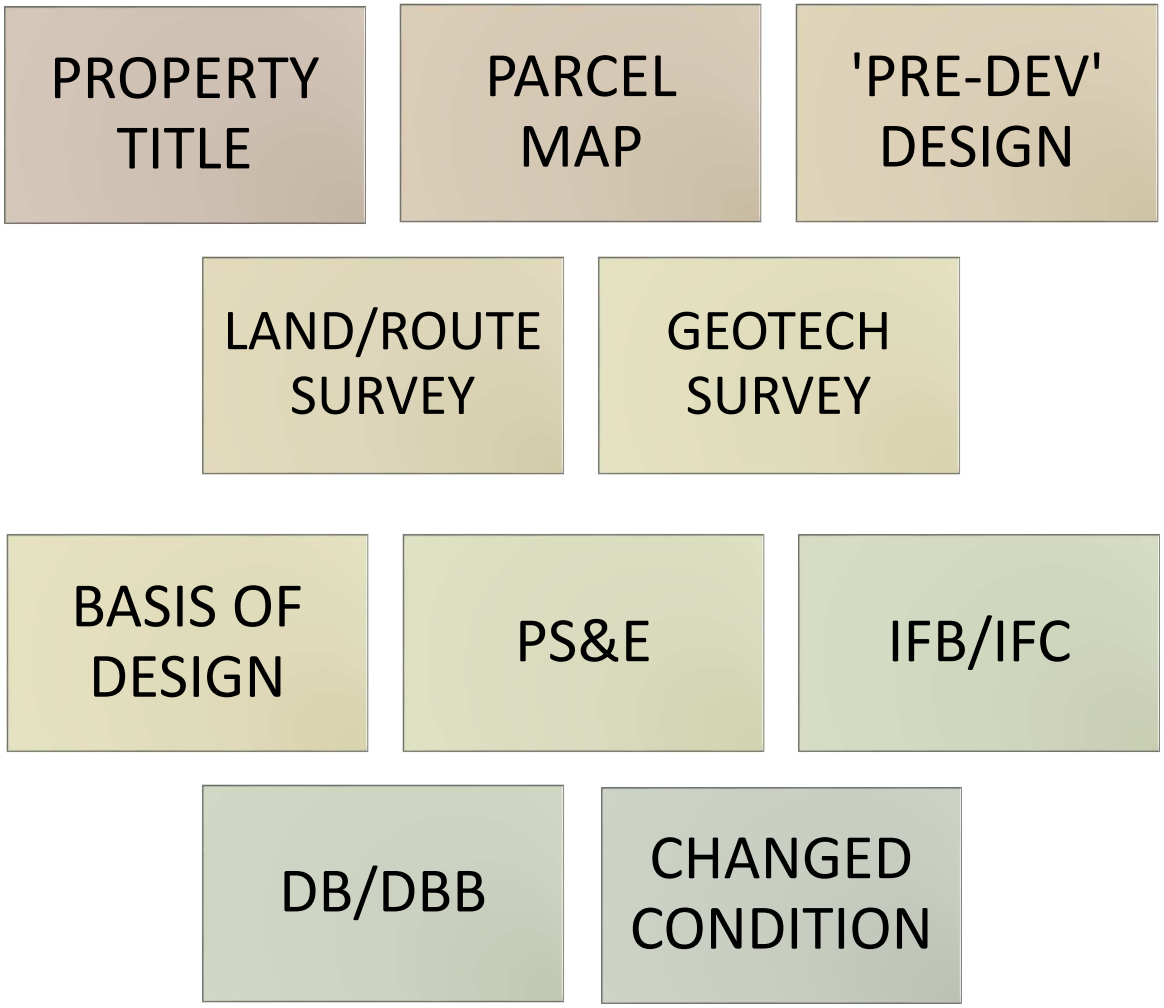
Figure 7 - Representative Construction Project Life Cycle [10] (aka "The S-Curve')

We'll see in the units on design discipline phases how much paperwork is required to initiate a project, but why is that considered such a small part of the (Stage 1) project life-cycle? Is this progress in physical construction, on budget payout, on employment staffing? *What is the real measure of project 'progress'?* How does an Owner decide what a reasonable progress payment request is for Consultants, and Contractors?!

● TASK: *Break up into A/B/C/D groups, each with one 'foreman', and discuss why construction progress is distributed as above. Think about how you would measure class progress in completion of this CDR course. As a group, with your instructor discuss student 'milestones' for their progress. Is finishing the textbook a Stage 1? Is doing homework Stage II and going to class Stage III? Is taking exams Stage IV? What daily determines 'progress' towards you achieving some mastery with Construction Document Reading? Chart your stage concepts for progress.*

[10] - Morris, Peter. (1987). The Anatomy of Major Projects: A Study of the Reality of Project Management. NJ:Wiley

Unit One Vocabulary - Go back and review these new word definitions before moving to Unit Two.



Assessment Rubric - In A/B/C/D groups, discuss briefly what was presented in Unit 1, and develop a 4-part rubric of the necessary sketches and class notes, terminology/vocabulary, conceptual framework and learning targets a student must demonstrate to show mastery of this unit.

Unit 1 Questions for Review:

1. Construction plans are necessarily: A. 1-dimensional; B. 2-dimensional; C. 3-dimensional

2. Two formal issue stages of construction documents are: A. NDT/NRA; B. POB/ETA ; C. IFB/IFC

3. Specifications provide the project with the _____ data: A. Technical; B. Legal ; C. Financial

4. Bid Documents refers to: A. Legal Contract terms; B. Quality Assurance; C. Project Close-out

5. Contractors need to get? A. Plans and Specs; B. Estimate; C. Plans, Specs and Bid Documents

6. The term 'A/E' refers to: A. Assurance Enabler; B. Architects/Engineers; C; Automated Estimating

7. The Jurisdiction doesn't need to receive the _____? A. Plans; B. Specifications; C. Estimate

8. Planning, Zoning and Permits are prepared by: A. Owner; B. Jurisdiction; C. A/E & Contractors

9. A Pre-Development Assessment is called a____?: A.PDA; B. Design 'Pre-Dev"; C. PD Assessment

10. Before Design begins, there must be a____? A. Building Plan; B. Estimate; C. Conceptual Plan

We have become inured to the technical difficulties of sourcing and contracting for fabrication and delivery. Our society is so consumer-oriented and push-marketed, so data-mined and deeply-clouded, we scarcely ever even bargain over the price, much less quality. If you intend to pursue a career in the construction industry, you will have to relearn 'value' and 'pricing'. Something as simple as paying $125 for an $18-value pair of sports shoes would be devastating in a project context. *They will rely on you as their construction document reader!*

Word for the Day: "**85% IFC**" – Architect and Engineer consultants are referred to collectively as '*A/E's'*. A/E's will often underbid the work in order to get selected, especially in Design-Build jobs. What the Owner or their Owner-Representative may not realize in looking at these '85% IFC's', is that the Architect or Engineer has cut-off further detail-design, and expects detailing will 'be taken care of by Change Order,' and, of course, any A/E's costs to register those changes will be an additional Change Order also. This is fraud, but, it's also common practice.

2 – Laying Out Construction Documents

Learning Objective: Students begin to develop a better understanding of the fundamentals of construction plan document representation.

Why are *lines* important? We represent building sites with lines drawn on paper, and everything about the building structure with more lines, and then all of the utilities with even more lines. Your goal as a student is to study these documents, and line-types, and learn their meanings. It's a new foreign language. *'Learning your lines'* just like an actor does, is what it means to *'read the construction plans'*. It's what this instruction book is about. Now, imagine we're living on the steppes of some distant Asian land, one without a single signpost or any point of geographic reference. There are no towns visible, no roads, no maps. We are entirely on our own in the wilderness. How would we find our way?

The Earth is round, like the Sun. So there are no straight lines in nature. We can all see that. And they say the Earth orbits the Sun on a slightly elliptical path, traveling about 1-degree per day, or 360- in a year. What else do we know? Well, go outside one night this week when the stars are visible. Use your online Google resources to locate Polaris, the North Star. The Earth's tilted axis of rotation points *close to* that North Star location, and has for as long as there has been written records. As a result, that *single point* in the ever-rotating celestial sphere 'never moves'.

Earth's rotation makes the Sun appear to 'rise' every morning in the East, more or less, depending on the season, and to 'set' in the West. The Earth's period of rotation has been at 24 hours, more or less, forever, and that allows the Earth to be divided into meridians of solar time. But if the Earth has 24 meridians of solar-day longitude, why are there 360-degrees in the equator year, instead of 365¼? And why are there only 90-degrees of latitude North and South from the Equator, instead of 180? Also, we know the Earth has a gravitational force, at every place on the globe, it's pointing more or less straight 'down'. With 'down', then there is 'up', and with 'up', now the concept of relative 'elevation' arises, from Death Valley up to Mount Everest on Earth. We measure that elevation distance (height) of everything on Earth from 'Mean Sea Level' (MSL).

● TASK: *Google, what does the term 'Mean Sea Level' mean? Who measures 'MSL'? And who said it? What is the 'Prime Meridian'?*

So we have North, South, East, West, 'Up' and 'Down' (Elevation), the X-Y-Z Cartesian coordinates that we use today. With a plumb bob to find the 'vertical', a knotted string-line for 'length', and the convention of a 'square', now the great structures of antiquity could be built. But where exactly? With the N-S-E-W cardinal ordinates established in the heavens, and the invisible lines of longitude and latitude defined by solar-time concept, our spherical Earth could then be sub-divided, measured and parceled off. Once the lands are sub-divided with invisible lines, then we can build these great structures according to some general plan. Ancient plans were either based on a central plaza with radiating-spoke-and-web thoroughfares, or a central square with rectangular grid thoroughfares of major and minor arterials, or a hybrid that hugged to the terrain and connected urban hubs with highways through the rural farming villages. *All of these master planning concepts rely on the premise that the spherical Earth of curved lines can be represented within a flat, two-dimensional orthogonal map, and then subdivided by using straight lines.*

● TASK: *Google, what ancient city is built on spoke-and-hub. Find one built on orthogonal grids. Find one that's 'beads on a string'.*

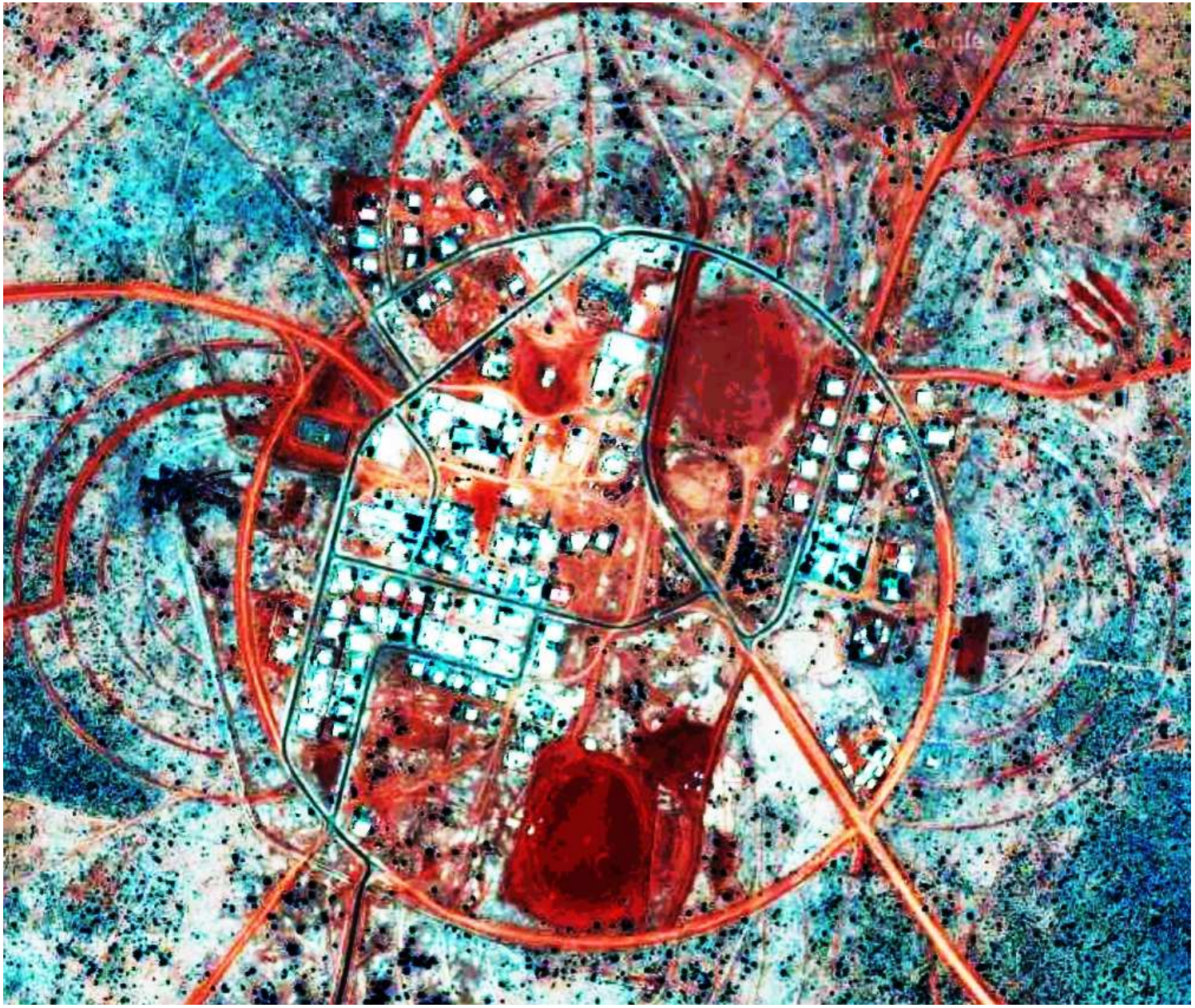


Figure 8- Papunya, Australia Aboriginal Settlement Plan (Google Maps)

● TASK: *Divide the class up into A/B pairs. In the sketch area of your Daily Log of Instruction, rough in a border and title block (below). Then, each team member should locate where they live using Google Maps on their smart phone. Zoom in until you can see your house. Using a ruler and protractor, transfer a sketch of your house and driveway and fence line into the drawing area of your Daily Log, with a Title Block. Make sure North is at the 'top'. Working as a team, measure the property and draw it's outline, then lay in the house, driveway, and sidewalks.*

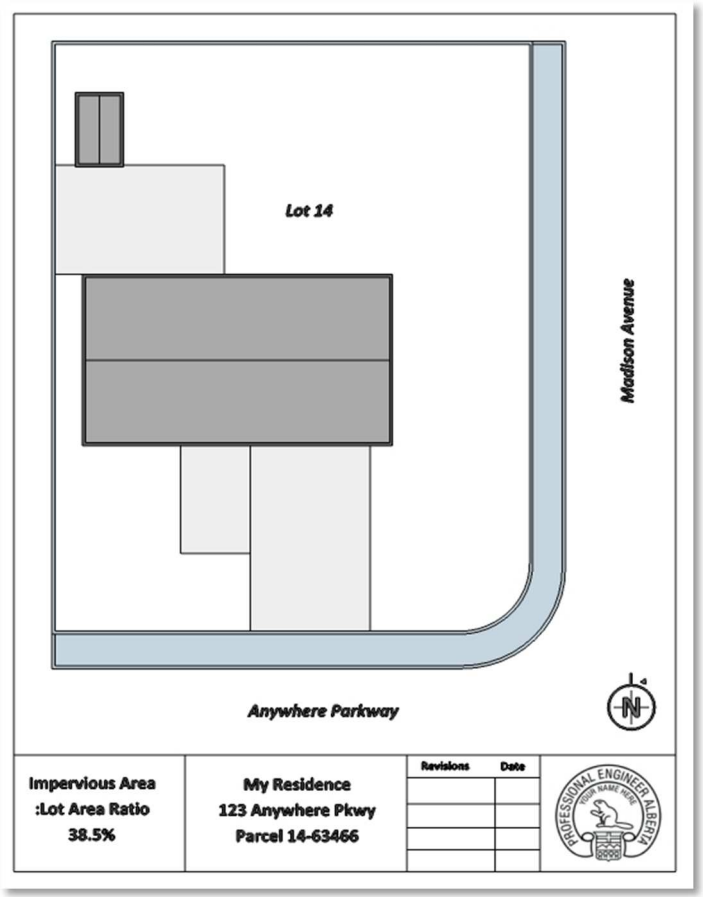
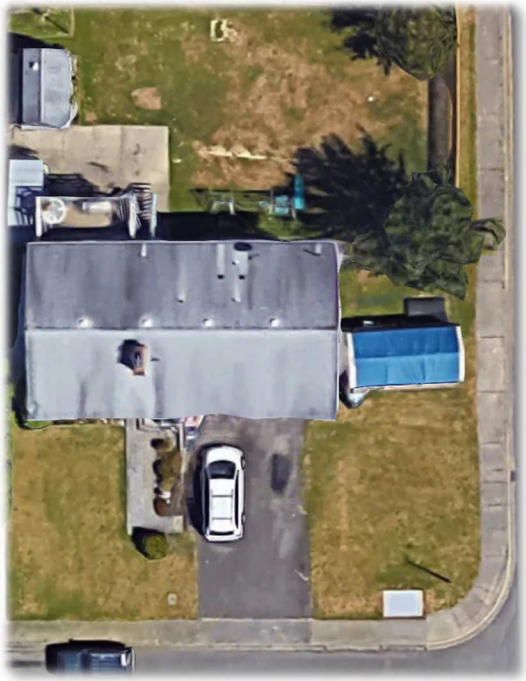


Figure 9- Example Sketch Off of Google Maps



NOTE: Remember on a 2D plan drawing we omit any vehicles and temporary structures, like that blue-tarp whatever that is, and that white top lemonade stand at the lower right. You are encouraged to sketch the trees on the end and bushes at the entrance. And what is up with the rippled eave of that roof!? Draw it as though straight.

Notice we created a title block in this exercise. For the project title, write, 'My Residence' (and its location), sketch in some detailed blocks for date, revisions, sheet number and so on. You'll use that template My Title Bock in future exercises, refining it until it matches the plan drawings that we will be practicing our construction document reading with. Of course, to match the requirements for a building permit site plan, we'll need quite a bit more information than just your Google Maps sketch. Let's take a look at those typical jurisdictional requirements:

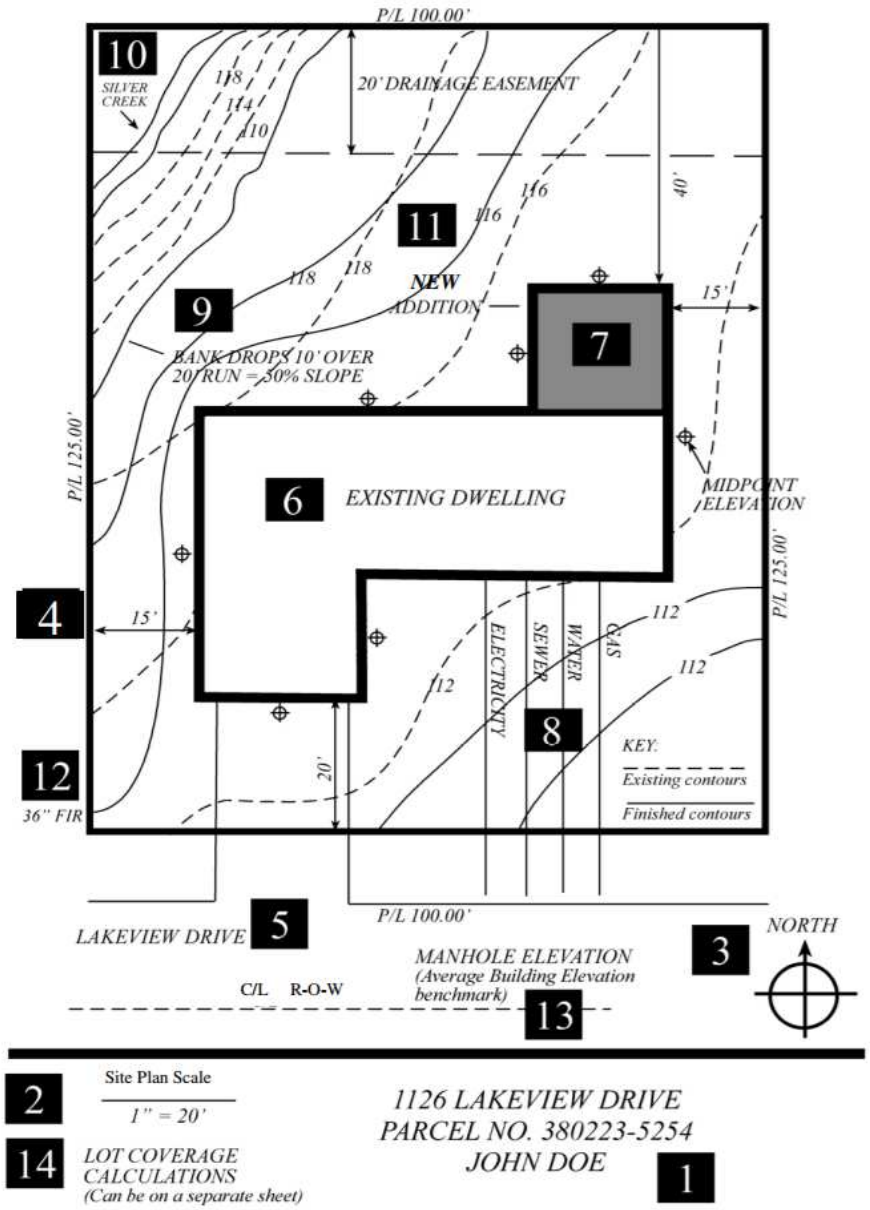


Figure 10 - Permit Application Site Plan Checklist (City of Des Moines)

1. The property owner's name, the assessor's parcel number, the site's address, lot number and plat name.
2. The map scale. A scale of 1" = 20' is typical but others, 1" = 50' for large sites, are also acceptable.
3. A north arrow, indicating the direction north.
4. All property lines, all easements (utilities, access, etc.), and site dimensions. Show the setbacks between buildings, and from buildings to all property lines and vicinity map.
5. All streets and alleys, with street names. Show all existing and/or proposed driveways. Provide the width of the driveway and a description of the paving materials. Show slopes and cross-sections if grades are over 10%. Indicate slope direction with an arrow.
6. The locations and dimensions of all existing and proposed buildings. Identify each building by its use (garage, residence, etc.). Include decks, retaining walls, and the like.
7. Clear distinction between the existing building and any proposed addition. Also show any buildings to be demolished.
8. Locations of storm water drainage, sewer, septic tanks/drain fields, water, electricity and gas lines, and any underground tanks.
9. Any steep slopes (30% or greater), and/or fill areas.
10. All surface water (creeks, streams, ponds, wetlands, etc.) within 200 feet of the property.
11. Indicate the slope (elevation change) of the site. Use contour lines or arrows to show direction of slope. Also indicate percent of slopes. Designate grade break lines and extend contour lines to identify adjoining property conditions.
12. Show method of (construction) storm water disposal. Show construction access route, buffer strips, sediment barriers, or other erosion control features as applicable.
13. Average building elevation bench mark.
14. Lot coverage calculations (building area divided by lot area).

● TASK: *Work with your partner to fill in the blanks in your plan.*

By now you should have an understanding how we got from a spherical Earth made up *exclusively* of curved lines, to an abstract orthogonal representation on flat plan drawings, projected on an X-Y plane with straight lines. Generally speaking, we draw using the orthogonal x-y-z Cartesian system, and don't rely on the radial (polar) r-θ-φ one, which is reserved for special applications, like rotating equipment geometry.

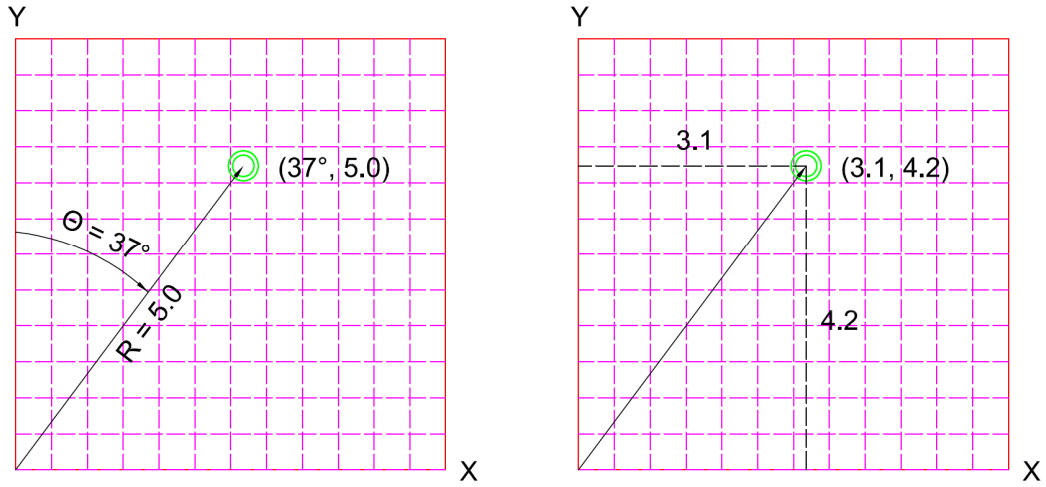


Figure 11- Polar and Cartesian Coordinate Systems Notation for Same Point

In the past, Draftspersons had to rely on manual methods: the mechanical pencil, the swing-arm tee-square, drafting board, and the eraser. A lot of erasures, and with careful orthogonal drawings measured closely with a 3-corner tri-scale. Only after the plans were drawn, with the sections and elevations laid in to clarify their vertical intent, only then was a perspective rendering made, carefully and exhaustively laid out according to the 'vanishing point' perspective rules of the Renaissance. This way the Client could grasp what the two-dimensional plans were showing, by looking at the perspective rendering. Using CAD computers that process can be flipped. With simple-to-draw block components and objects, a perspective 3D scene that looks virtually real (in a cartoonish sense) can be 'massed', modeled, shaded and illuminated *in a single afternoon.*

You may not appreciate this unless you are a Designer yourself, but the advent of 3D CAD is a *huge* marketing factor for young entrepreneurs! Before, a Designer lived or died on their well-established *reputation*. Clients knew what to expect from a Designer, even if they had no inkling of how their project would look, so were willing to pay and wait for months. *With 3D CAD, now anyone can walk in with a fresh new pitch~!* You see? With just a day or two of 3D visualization talent, an unknown Designer now has just as much marketing power as an established one. Then your Client becomes your partner in the design development, before the long laborious effort to break the 3D model into component 2D plans, sections, elevations and details. Clients can easily understand what they're looking at. Moreover, for initial planning, the 3D computer rendering doesn't need to be 'complete'. We often use hollowed-out false-front shapes, like Hollywood movie sets, that from certain positions and deliberate detail and lighting, look completely authentic to convey project intent, as the false-front perspective illustration below shows.

From here on, we can begin to discuss 'surveying' those lines for land parcel plot plans, as the essential start to any design and construction projects. Because you will need to know that geometry and trigonometry to work within the construction industry, now's a good time to dust off those textbooks. We hope you will also look at the references in our bibliography. This course will be more meaningful to you, when you learn how to sketch.

We also want to review the organization index structure of CAD plan documents, using the **US National Cad Standard V6** [11]. Plan numbering nomenclature should be in a form 'AI-1-01'. The first letter is the *discipline*, and the second letter the related *sub-discipline*. The first digit, is the drawing sheet *type* - plans, sections, details, etc. The last two digits are a sheet *sub-index*, from 01 to 99, *within that individual discipline*.

Sheet revisions are itemized separately.

Figure 12- Billboard Signage Look-and-Feel Study on False-Front Building Shell

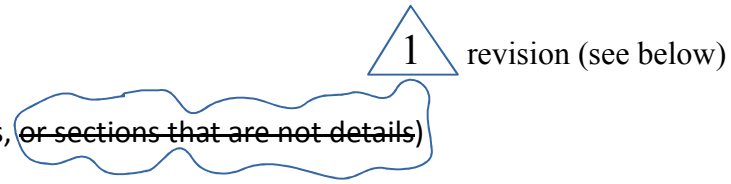
SHEET DISCIPLINE DESIGNATORS:

-	Cover Sheet (Title Sheet)
G	General Notes
H	Hazardous Materials
V	Survey / Mapping
B	Geotechnical
C	Civil
L	Landscape
S	Structural
A	Architectural
I	Interiors
Q	Equipment
F	Fire Protection
P	Plumbing
D	Process
M	Mechanical
E	Electrical
W	Distributed Energy
T	Telecommunications
R	Resource (existing conditions)
X	Other Disciplines
Z	Contractor / Shop Drawings
O	Operations

11 - https://www.wbdg.org/ccb/browse_cat.php?c=206

SHEET TYPE DESIGNATORS:

0 - General (symbols legend, notes, etc.)
1 - Plans (horizontal views)
2 - Elevations (vertical views)
3 - Sections (sectional views, wall sections)
4 - Large-Scale Views (plans, elevations, stair sections, ~~or sections that are not details~~)
5 - Details
6 - Schedules and Diagrams
7 - User Defined (for types that do not fall in other categories, including typical detail sheets)
8 - User Defined (for types that do not fall in other categories)
9 - 3D Representations (isometrics, perspectives, photographs)



revision (see below)

REV	DATE	DESCRIPTION
1	10/04/2016	Delete '...or sections that are not details'

Small revisions to a plan sheet are marked with a cloud and numbered triangle, then listed in a revision table in the title block. Major sheet revisions add a suffix R and a numeral: AI-1-01-R1. Total revisions and scoping changes *replace* the previous drawing, then use an X suffix and a numeral: AI-1-01-X1**.** It's important to note these are only guidelines, as the construction industry moves to 3D- GIS-BIM. In many cases, especially in industrial process design work, the AIA-style notation is not followed. NOTE: It's *essential* for the student to learn this formatting standard, and the related GIS-BIM components, although it is not necessary to learn how to design-draft in CAD for this course.

● TASK: *Your goal isn't just to learn some rigid form, but rather, to know what the proper form should be, then through experience studying and interpreting many different sets of construction documents, (and every IFC set is different), you will be able to spot obvious errors at first, then small but trivial errors, and finally, as a certified construction document reader, you will be able to find those few catastrophic errors. Break into four teams at the board. Your instructor will read off some sheet designators. Whoever gets the right description first, gets points.*

Speaking of 'catastrophic errors', a building project had suffered a sagging roof right before winter storms and snows. The engineer-reviewer surveyed the construction, looked at the plans in detail, everything seemed to be OK. As a last shot, he read the design analysis for the heavy timber framing structure, and there, right there, instead of a (-) sign on snow loading, there was a (+) sign. Just a tiny, tiny error! But because the snow loads were not applied correctly (+ is up, instead of – is down) in the timber framing model, there was no other recourse. The new building project had to be terminated. All the construction document reviewers who had signed off on those plans were thoroughly disgraced. Then Code review of the plans found even more errors! Lawsuits flew! Companies were bankrupted! People lost their careers in the fallout!

→(+)← This is what a **$10 million** design error looks like!
*Every set of construction plan documents has **e r o r r s !***

Along with construction drawings formatting goes construction specifications formatting. Construction specification detail the requirements for each phase or stage of construction. Again, you don't have to memorize them, but you have to adhere to them as a standard. The Architects Institute of America (AIA) and Construction Specifications Institute (CSI) have developed a Master-Format specification.[12] NOTE: The US military has their own 'MilSpec' format, Unified Facilities Criteria (UFC) and Unified Facility Guide Specifications along with Specs-Intact, which is the Guide Specification *editing* program developed by NASA for all DOD Defense Agencies. [13]

Originally, the MasterFormat was organized into 16 Divisions, and most Cost Estimates will still use those headings today for convenience:

SPECIFICATION SECTION DESIGNATORS:

Division 01 — General Requirements
Division 02 — Site Construction
Division 03 — Concrete
Division 04 — Masonry
Division 05 — Metals
Division 06 — Wood and Plastics
Division 07 — Thermal and Moisture Protection
Division 08 — Doors and Windows
Division 09 — Finishes
Division 10 — Specialties
Division 11 — Equipment
Division 12 — Furnishings
Division 13 — Special Construction
Division 14 — Conveying Systems
Division 15 — Mechanical
Division 16 — Electrical

The new master template was expanded and standardized to 'xx xx xx' format: 00 00 00 Procurement and Contracting Requirements is general contract information. 01 00 00 General Requirements is general construction information. 02 00 00 Existing Conditions is general information for the existing conditions, then 03 00 00 Concrete begins the specific construction standards, through the trades and disciplines activities, now all the way to 48 00 00 Electrical Power Generation. Each sub-section under each title addresses specific activities within each main section. Then within each activity the subtasks are outlined under PART 1 – GENERAL, which describes the general conditions of the work, their measurements and payments. PART 2 – PRODUCTS describes the materials and products which are pre-approved. A Contractor may always suggest alternates, but still risks disapproval. PART 3 – EXECUTION describes the methods of work, and field Quality Control of that work.

These specification standards are for the convenience of all parties. There are pre-written versions of every standard that can be edited down or fill-in-the-blank'd. One weakness with this is the 'copy-and-paste' mentality, where an A/E design team might copy the specifications from a similar project, lightly edit them, then issue them for bid. This is often a problem in public works, where the office staff may not be fully field-experienced in the work they are contracting for, and the field inspection staff haven't the experience to recognize the office errors. *You can be sure the Contractor has expert specification readers looking for all these deficiencies.* For this reason, State DOT standard specifications and

12 - http://csinet.org/numbersandtitles
13 - http://everyspec.com/library.php

standard design details are rigidly formatted and carefully prepared. No 'specs' mistakes can be tolerated on a bridge or a tunnel project! Your task as an apprentice construction document reader is to become so familiar with the specifications formatting, like reading sheet music, that you can read fluently, and spot mistakes more easily. *Bidding contractors/suppliers are in a position of superior specifications knowledge and may withhold discovered errors about the construction documents for their own competitive advantage.* Where there is a conflict between the plan drawings and the specifications, the specifications are generally given a preference. But when an A/E design team is putting together their plan drawings before the specifications are written, most of their effort is spent in getting drawings 85% done and corrected, *then they are rushing to finish document deliverables within the deadline and their budget quote.* This now becomes your problem, and as you'll see with the Contract Documents, the dense legalese language that's evolved is why ***~2/3rds of construction claims are from flawed specifications!***

Along with Plans and Specifications goes the Estimate, and together these are referred to as a *'PS&E'* package. The Estimate is an itemized breakdown of every task, using MasterSpec number format. Within every task, is a quantities breakdown of the Labor, the Materials and the Equipment needed to get work completed: Task, Phase, Labor, Materials, and Equipment. Each is broken out by Quantity, Unit and Unit Cost.

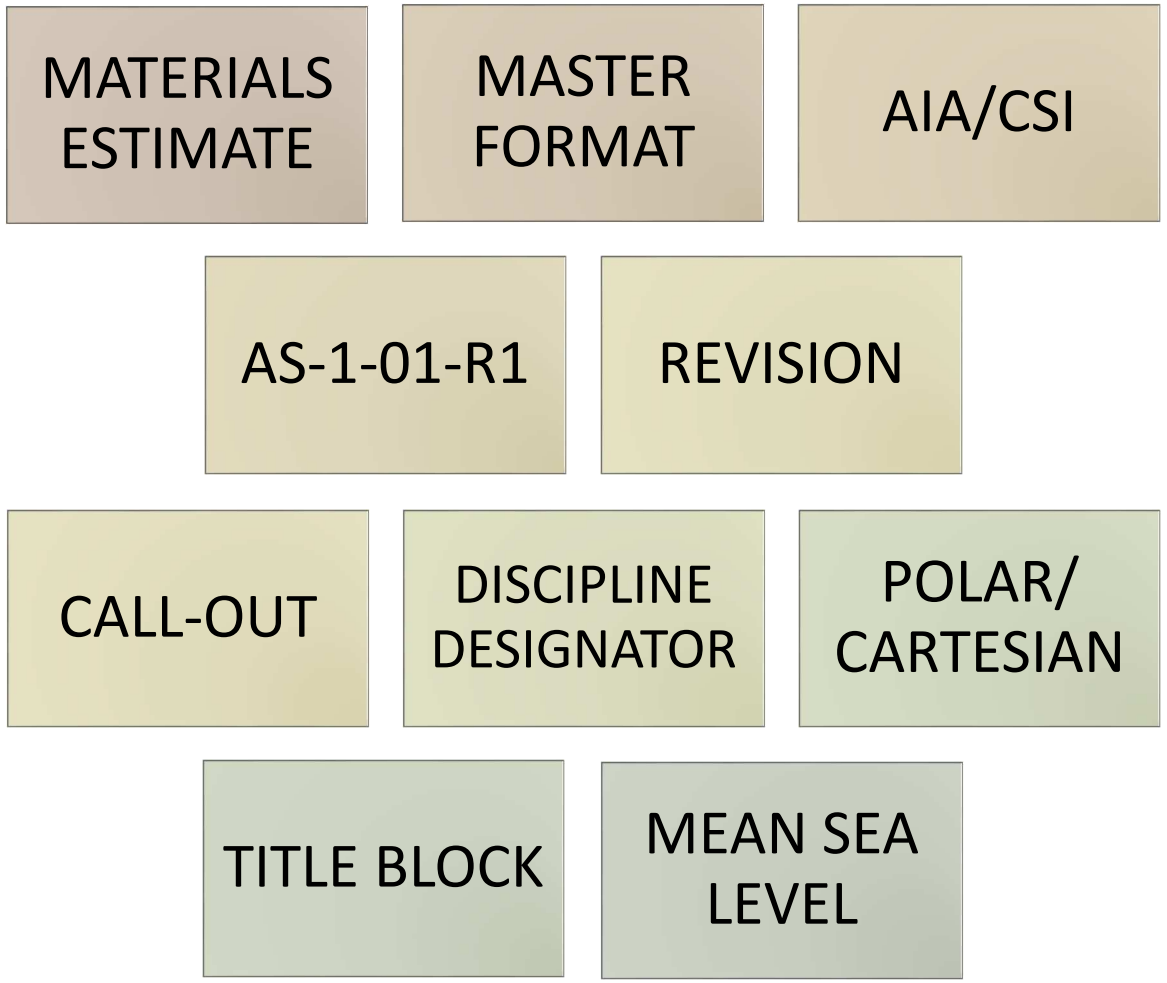
Item- LSR Unit / Basic Requirements / LSR Division or Section	LSR Unit Total	Unit Type/sub $	TI Plan Unit Total	Unit Cost	Total Cost
DEMOLITION / DIV 2					
Demolish and Salvage Existing Interior Doors	1	ea	66	$ 132.75	$ 8,761.50
Demolish Existing Interior Walls (see Div 16 for Electrical / Tel / Data demo)	1	lf	1578	$ 40.57	$ 64,019.46
Demo / Recycle Existing Carpet + Gypcrete	1	sf	33184	$ 1.25	$ 41,480.00
GYPCRETE / DIV 3					
Pour new gypcrete floors	1	sf	22469	$ 1.85	$ 41,566.73
WOODS and PLASTICS / DIV 6					
Refinish All Window and Trim Woodwork to Remain (Allowance)	1	LS	1	$ 5,000.00	$ 5,000.00
THERMAL and MOISTURE PROTECTION / DIV 7					
Remove and Replace (13) Windows for Demolition and Ventilation	1	LS	1	$ 4,195.00	$ 4,195.00

Figure 13- Excerpt from Tenant Improvement Estimate

● TASK: *Divide the class up into A/B pairs. One student play Estimator, one play Owner. Make up your own unit prices, then finish filling the template below, and total. Make sure you add down, then check-add back up again! http://www.allcostdata.info/index.html has sample values you can apply. Bookmark this. Then as a class group, with your instructor, go over an estimate preparation from the WBDG standard: UFC 3-740-05 Handbook: Construction Cost Estimating, with Change 1: http://www.wbdg.org/FFC/DOD/UFC/ARCHIVES/ufc_3_740_05_2010.pdf Add it to your e-library. A convenient folder scheme is using Division 01 to 16 and the design disciplines to keep your e-references organized.*

ITEM & DIVISION	NO OF UNITS	UNIT TYPE	UNIT COST	SUBTOTAL (NO UNITS x UNIT COST)
MOBILIZATION DIV 1 – Move Equipment to -and- from Work Site	1	Lump Sum (LS)	$11,500.00	$11,500.00
SITEWORK DIV 2 – Excavate & Backfill Trench	240	Lineal Feet (LF)	$ 24.53	$ 5,887.20
18” RD Storm Sewer	240	Lineal Feet (LF)	$	$
Standard Type II Manhole	3	Each (EA)	$	$
Deliver to Site and Install	1	Lump Sum (LS)	$	$
CONCRETE DIV 3 – Excavate & Backfill Footings	1250	Cubic Feet (CF)	$	$
Reinforcing Bars	2.5	Tons (T)	$	$
5000 psi Concrete	37	Cubic Yards (CY)	$	$
Deliver to Site and Pump	1	Lump Sum (LS)	$	$
MASONRY DIV 4 – Standard 8x16 Cinder Block	424	Each (EA)	$	$
Reinforcing Bars	1.4	Tons (T)	$	$
J-Bolt Anchors	18	Each (EA)	$	$
3000 psi Grout	4	Cubic Yards (CY)	$	$
Deliver to Site and Pump	1	Lump Sum (LS)	$	$
METALS DIV 5 – Metal Building Framing Package	1	Lump Sum (LS)	$	$
Galvanized Sill Plate L4x4x3/8 (by Owner)	124	Lineal Feet (LF)	$	$
Furnish, Deliver and Install	1	Lump Sum (LS)	$	$
			PG1 SUBTOTAL	$

Unit Two Vocabulary - Go back and review these new word definitions before moving to Unit Three.



Assessment Rubric - In A/B/C/D groups, discuss briefly what was presented in Unit 2, and develop a 4-part rubric of the necessary sketches and class notes, terminology/vocabulary, conceptual framework and learning targets a student must demonstrate to show mastery of this unit.

Unit 2 Questions for Review:

1. Estimates itemize _____ costs: A. Labor, Materials & Equipment; B. Design; C. Survey

2. Plans, Specifications and Estimate are referred to as ____?: A. Plan Set; B. Permit Set; C. PS&E

3.Specification numbers go from 00 00 00 to _____?: A. 24 00 00; B. 32 00 00; C. 48 00 00

4. A Civil Structures Sections drawing is labeled _____?: A. SR-2-01; B. CM-5-01; C. CS-3-01

5.Sheet CS-1-01-X1 is a _____ of sheet CS-1-01: A. Reference; B. Revision; C. Replacement

6. The three principle-axis drawing directions are designated by: A. A-B-C; B. X-Y-Z; C; N-S-E

7. When drawing building plans, we draw in _____ coordinates? A. Zenithal; B. Polar; C. Cartesian

8. The area of text information on a drawing border is the: A. Designator; B. Title Block; C. Category

9. Sheet EQ-1-01 is an: A. Equipment Schedule; B. Electrical Equipment Plan; C. One-Line Drawing

10. Where you see a cloud and a numbered triangle, that's a: A. Revision; B. Section; C. Detail

Think of it this way, those of you who play instruments or speak a foreign language. When you started, it was awful. Nothing made sense. Reading a symphony's sheet music, or a descriptive essay written in another language was terrifying! As you practice, practice, practice, (there is no substitute,) you gained fluency. What once was scary is now delightful! You can play a symphony or converse with a foreigner. The same goes for document reading. It's the mental discipline to practice over and over again with the will to excel. *Learn your lines!*

Word for the Day: "SWAG" – A/E design consultants will seldom consult with professional estimators in preparing the Budget portion of their PS&E submittal to the Owner. However, a General Contractor lives or dies by his/her professional Estimators. Where the difference comes in between the Owner's budget recommended by the A/E, and the Contractor's bid proposal, is the A/E's 'SWAG' or 'Strategic Wild-Ass Guess' for what a line item or a work task will cost. You'll often hear them say, 'Just SWAG it'. This is fraud, but it's also a common A/E practice.

3 - The Site Survey Drawings

Learning Objective: Students develop an understanding of the metrology of property and route survey maps for construction plan documents, and how to interpret the symbols and linetypes used by professional survey consultants, while learning a little about the math that is involved.

Using the number of degrees Westerly or Easterly around the Equator from the 0° longitude Prime Meridian in London (why?) and the degrees Northerly or Southerly measured from the 0° latitude on the Equator, (why?) any point on the Earth can be defined by its Northerly/Southerly and Westwardly/Easterly global coordinates, using the form of: **N**27° 43' 02" **E**85° 19' 27", using degrees, minutes and seconds of an arc.

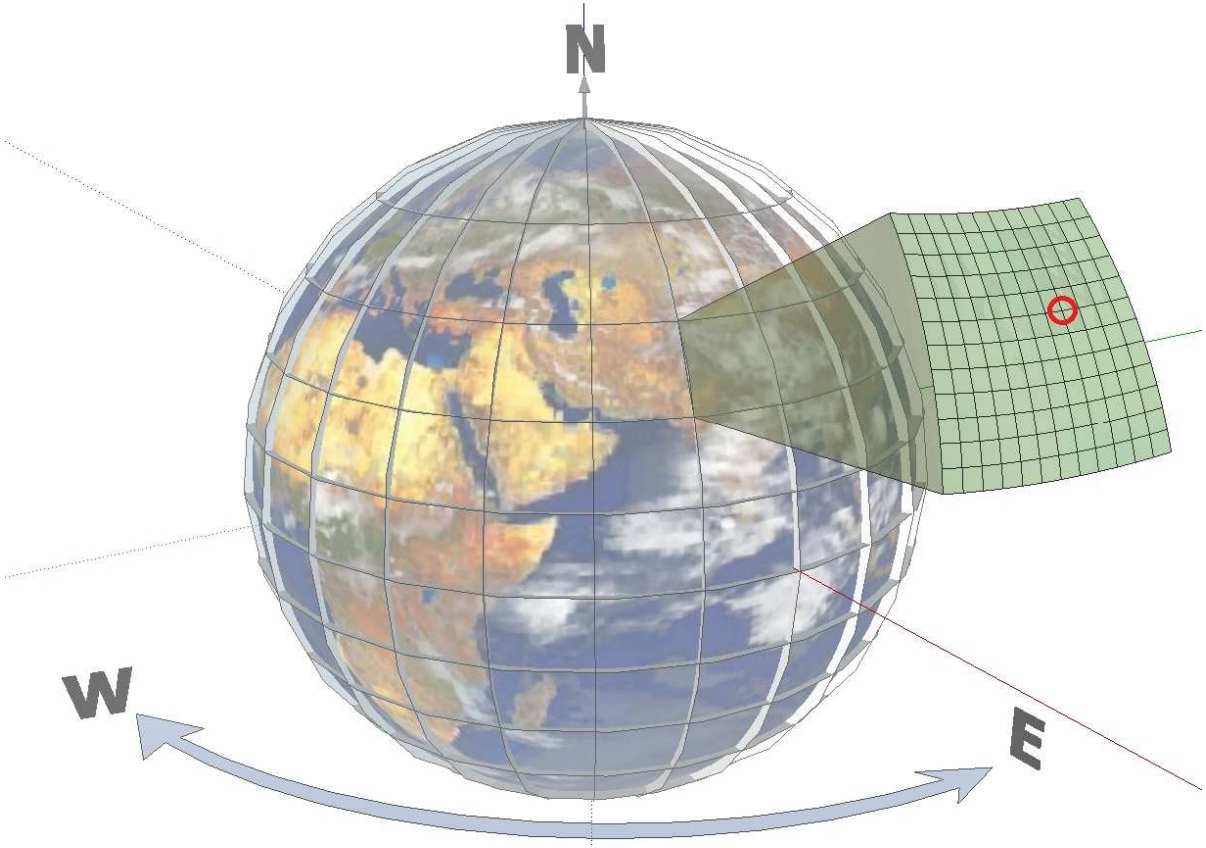


Figure 14- Earth is Divided by Lines of Longitude (W-E) and Latitude (N-S)